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PUBLIC HEALTH REPORTS

VOL. XXVIII. JUNE 6, 1913. No. 23.

OUTBREAK AND SUPPRESSION OF PLAGUE IN PORTO RICO.

AN ACCOUNT OF THE COURSE OF THE EPIDEMIC AND THE MEASURES EMPLOYED FOR ITS SUPPRESSION BY THE UNITED STATES PUBLIC HEALTH SERVICE.

By RICHARD H. CREEL, Passed Assistant Surgeon, United States Public Health Service.

[Continued from Public Health Reports, May 30, 1913.]

Eradicative Measures Outside of San Juan.

CAROLINA.

In the latter part of June human plague cases occurred in the town of Carolina, a small village about 14 miles from San Juan.

On June 26 a case, clinically positive, was reported. The patient died on June 27. On June 28 another death from plague occurred in the barrio of Loiza, some 3 or 4 miles distant from Carolina on the side of town opposite from San Juan. The residence in which he had developed symptoms and died was a small shack out on the hills, well elevated and far removed from other habitations. Investigation revealed the fact that the man had been in Carolina overnight on June 22 and had slept in a house where subsequently "Case 3, Carolina," developed its infection. This case was confirmed by animal inoculation July 5. The third and last case of plague in Carolina sickened July 16, died on July 18, and was bacteriologically confirmed on July 18. In all, 7 infected rats were taken from Carolina out of a total of 350 examined.

The local health officer in Carolina, pursuant to orders from the director of sanitation, immediately attended to the mechanical cleaning of the town, removal of rubbish, etc. On July 4, Asst. Surg. C. L. Williams was ordered to Carolina. Dr. Pedro Malaret, of the insular department of sanitation, was in joint control with Dr. Williams until July 12, when he left for work in Rio Piedras. The work instituted at Carolina consisted in summary destruction of rat harborage, and in rat proofing, with the incidental capture of all rodents possible. Mr. Walter St. Elmo, of the insular police, ably assisted in all the work at Carolina.

One of the most marked cases of rat infestation of mamposteria walls occurred in Carolina. The house was one in which cases 2 and

3 acquired their infection. The walls were 2 or 3 feet in breadth, and rat holes were seen, not only toward the floor but at different levels up to the ceiling. When the second case occurred in this house it was so evident that rat-proofing by any expedient whatever would be of doubtful efficacy, that, in view of the place being such a focus of infection, it was decided not to stop short of thorough removal of the harborage, and consequently the walls and floors were destroyed. Nine rats were taken from the interior of the walls. At one place the rats had excavated a hollow space of at least a quart capacity. The report of Asst. Surg. Williams is appended hereto. He was detached from Carolina on August 11 and was sent to Ponce when plague preventive measures were instituted in that place.

It is highly probable that the infection was transmitted to Carolina from San Juan by means of rats in merchandise. This assumption is supported by the following: The distance of Carolina from San Juan and the appearance of human and rodent plague in Carolina so soon after the discovery of the infection in San Juan; the first patient attacked had not been out of Carolina, but worked in a warehouse handling merchandise from San Juan; no known infection had occurred at intervening points.

DORADO.

On July 13 a suspicious death was reported from the town of Dorado, distant from San Juan about 15 miles. The post-mortem examination established a diagnosis which was confirmed by animal inoculation July 17.

The town is quite small, being a mere group of houses. An insular health official was sent to Dorado to institute antiplague measures at that place. Some 10 rodents were captured and examined without discovering any infection among them. The case, a boy of 13 years, was accustomed to frequent the vicinity of the depot. He is said to have stolen a ride on a freight train from Dorado to Camuy on July 11. The probability of an extension of infection by overland migration of rats from San Juan does not seem likely, as no other case, human or rodent, occurred in Dorado or the surrounding country in so far as is known. This case seems to be of sufficient interest to merit a special case report, which is contained in Appendix II.

CAGUAS.

A force of service rat trappers was put to work in Caguas in early August.

Rodents from this place were examined in the service laboratory at the rate of about 100 per week.

On September 23 an infected *Mus norvegicus* was trapped, diagnosed on September 24, and verified by animal inoculation. On

October 14 a second *Mus norvegicus* was taken in the opposite side of the town, a third on December 9, and again on December 21 an infected **Decumanus** was trapped. No human cases so far as is known occurred in this town. Caguas is located on the highway leading south from San Juan, about 23 miles distant.

Aside from the general sanitary conditions, the town is full of houses that furnish rat harborage, both by reason of their roofs of country tiles and their lack of elevation. In September but little had been done toward rat proofing. The local health officer had realized the threatened danger, but his attempts to secure improved conditions had been more or less nullified by the apathy of the general public and the indifference of the city courts in administering the law.

When the first plague rat was caught, some 50 men were at once employed to summarily destroy all rat harborage in the block in which the plague rodent was trapped, as well as the four contiguous blocks. The tile roofing and the floors of all buildings close to the ground were removed. The earth beneath all houses was drenched with petroleum as soon as flooring was removed. Fifty rodents were captured from the plague block, including 15 from the same house that the infected rat came from. One-third of these rodents were taken from the roofs. The force of rat trappers and poisoners was doubled, and part of the office and field force was transferred from San Juan to Caguas. No other infected rat being discovered for two or three weeks, the work of rat proofing and rat poisoning assumed a more leisurely rate of progress. Upon the discovery of the third and fourth rodent case, it was decided to send Asst. Surg. Williams to Caguas, with an increased force of inspectors and employees. His report of service operations is attached herewith.

The means by which infection reached Caguas is of interest, but it can be only speculation as to whether it was due to the transfer of an infected rat from San Juan in railroad freight or a land extension along the highway.

An infected rat was taken from Rio Piedras on July 12. This village is about 3 miles from San Juan on the road to Caguas. The rodent was picked up dead in the street, and as no other rodent infection was thereafter discovered in Rio Piedras and no human cases occurred, it is not beyond reason that it might have been a solitary migratory rat. A survey of the Rio Piedras-Caguas turnpike in the latter part of September elicited statements to the effect that there had been a noticeable mortality among the rats at several intermediate points two or three weeks prior to the discovery of the first infected rat in Caguas, but nothing more tangible pointing to a rural spread of the infection was discovered.

ARECIBO.

Among the rodents examined at the laboratory on October 12 a suspicious *Mus norvegicus* was discovered and was proved to be positive for plague by animal inoculation on October 15. On October 26 another plague-infected *Mus norvegicus* was taken from Arecibo.

Arecibo is a seaboard town located in the northwestern part of the island about 80 kilometers from San Juan. It is the fourth city in population in Porto Rico, having about 15,000 people, and is a clean, well ordered town, with considerable municipal pride. In general the sanitary conditions were good, but there was one district on the water front composed chiefly of shacks, badly crowded together, without sewage or garbage disposal. Being on a slope, however, there was no rat harborage on a large scale, but the squalid habits of the people made for more or less rat infestation by furnishing an abundant food supply. In the better sections of the town there were quite a large number of rat harbors in the way of food depots and dwellings. So far as is known no human cases occurred in this town either before or after the infected rats were discovered. As soon as the focus was discovered, the rat-trapping force in Arecibo was increased and rat-proofing measures were at once initiated by the insular department of sanitation.

In January Passed Asst. Surg. Ridlon was transferred from Mayaguez to Arecibo, and with him were sent two inspectors who had had extensive experience in rat-proofing in San Juan. In addition to the other service operations, a special laboratory was started, where rodents were examined not only from Arecibo but also from Manati and Aguadilla.

On February 15, 1913, eradicative measures were turned over to the insular department of sanitation. Dr. Ridlon's report is appended hereto.

The means by which infection reached Arecibo was probably infected rodents in merchandise from San Juan. The infection of the Dorado case on July 8 bears rather strongly on this assumption. The large number of intervening points which remained free from infection precludes the possibility of an overland extension.

Extension of Service Operations to Noninfected Points.

Bearing in mind the possibility of unknown rural spread of infection among the rodents of Porto Rico, it was decided in early August to extend service operations to other points in the island. Bureau authorization for this increased function was requested and granted, the amount of service funds available for this extension of work being increased from $5,000 per month to $7,500 per month, exclusive of the amount spent in connection with quarantine. A rat-trapping force was sent to Carolina, Rio Piedras, and Caguas. Later on trapping was started in Arecibo, Bayamon, Manati, and Aguadilla.

Passed Asst. Surg. Ridlon, on being relieved of the charge of the San Juan laboratory by Passed Asst. Surg. Chapin, proceeded to Mayaguez and instituted plague preventive measures in that city.

Asst. Surg. Williams was likewise relieved from duty in Carolina and proceeded to Ponce for the purpose of instituting plague suppressive measures at that point. The report of these officers is appended hereto. No plague infection was discovered in the above-named places, except in Caguas and Arecibo, mention of which has been made.

Laboratory.

As has been stated before, the laboratory building was well isolated and admirably adapted for the purpose, having been selected by the director of sanitation and Surg. S. B. Grubbs. Maj. F. F. Russel equipped the building and operated the laboratory from June 30 to July 9. Passed Asst. Surg. J. R. Ridlon was in charge from that date to August 8, when he was relieved by Passed Asst. Surg. C. W. Chapin. Dr. F. J. Hernández, who is the assistant bacteriologist in the insular laboratory, was appointed acting assistant surgeon in the service and aided the above-named officers in the laboratory work until January 1, when he resumed his position with the insular government.

The method of rodent examination in the laboratory was the same as used in the service operations in San Francisco. Laboratory attendants tacked the rodents to shingles, dissected them, and made clerical records concerning their source and any other data pertaining to the work. The appearance of the gross lesions was depended upon for diagnosis and animal inoculation was required for purpose of confirmation of the diagnosis of plague in rats.

There was a marked reduction of infected rats in August, but a reliable estimate of rodent infection from the beginning of the epidemic in San Juan is precluded for several reasons. In the first week of rat examination there was no widespread trapping. The rodents came from a comparatively small area. The town people at first turned in many rats, but later, as suppressive measures worked an inconvenience, they burned them. The difference of technique employed during the first week or two and that used during the remaining weeks of the epidemic might be another source of error. The first rats were diagnosed by smear only, a bipolar bacillus determining the diagnosis; whereas later the gross lesions were considered and confirmation by animal inoculation was required.

During July and August a considerable number of rodents were encountered presenting marked subcutaneous injection with bubo.

Smears made from the tissues would not infrequently show bipolar bacilli. Without animal inoculation these rodents might have been considered as probable plague. Rodents presenting this appearance were generally marked "suspicious" pending the result of animal inoculation. No great stress, however, was laid on the appearance of the smear from suspected rodents, as the invasion of all tissues by saprophytic organisms will not infrequently cause bipolar organisms to appear in the prepared smears, more especially if carbolthionin or Archibald's stain be used.

In addition to the examination of rats a number of mongoose which were caught in traps were sent to the laboratory for examination. None of them was found infected.

There was no evidence of chronic plague among any of the infected rats, unless the last rat from Caguas be so considered. This rodent had no bubo nor any gross lesion indicating plague. It was found dead on the premises from which "rodent case No. 3, Caguas," had been trapped, and for that reason white rats were inoculated with some of the tissues from this rat. The rat proved to be plague infected. The only lesions observed in this animal were adhesions of the pleura and of the spleen and liver. No bubo, pleural effusion, granulations in the viscera, or subcutaneous injection was noted.

Character of building from which infected rats were taken.

From dwellings	23
From food depots	8
From steamships	2
Turned in untagged	[1] 21
Found dead on streets	10
Taken from stables	2
Total	66

Rat Infection.

Sixty-six rats were diagnosed as infected, 34 prior to service assumption of the work and 32 subsequently. Of this total, 52 were from San Juan, 7 from Carolina, 4 from Caguas, 2 from Arecibo, and 1 from Rio Piedras. The first plague rats were diagnosed from smear only, the others by smear and gross lesions of rat, and confirmed by guinea pig inoculation.

Prior to July 1 the species was not reported.

Classification of infected rodents.

Mus norvegicus	37
Mus rattus	4
Mus alexandrinus	1
Mus musculus	[2] 2
Unclassified	22
Total	66

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[1] Most of these were examined in first week of the epidemic.

[2] These two rodents, reported as mice, were taken from the house of a human case on June 24. On inquiry at a later date it developed that the prepared smear was examined by bacteriologist without seeing the rodents. The laboratory attendant, who prepared the smears, stated he was uncertain whether the rodents were mice or young rats—though they were reported as former species. With this exception all plague rodents examined prior to June 30 were tabulated as "rats."

Flea Survey.

The number of live rats examined during the months of July and August, for fleas, was not sufficient to estimate the percentage of infestation. The species of fleas found were: *Xenopsylla cheopis, ctenocephalus canis, echidnaphaga gallinacae,* and the *rhynchoprion penetrans* (chigoe). The latter species of flea is quite frequently found on human beings in San Juan, but was not found on rodents. Burrowing beneath the skin it ovulates, making a very painful nodule. Several plague cases were found to have these chigoe nodules. It would be of epidemiological interest to know whether the female immediately penetrates the skin of her first host and ovulates, or whether she may feed on one or more hosts prior to depositing her eggs. This was not determined.

Passed Asst. Surg. C. W. Chapin reports the following series of flea counts in San Juan:

Date.	Number of rats examined.	Number of fleas.
Sept. 14–Oct. 14	54 living	18 *Echidnaphaga gallinacae.* (All from a lot of 6 Norvegicus.)
Oct. 24–Nov. 12	110 living	None.
Oct. 24–Nov. 15	2,022 dead	[1] 24.
Nov. 16–Dec. 4	130 living, 751 dead	None.
Jan. 17–Feb. 15	59 living, 1,399 dead	[2] 94.

[1] Some of these 24 fleas were lost or mangled. Of the 12 identified, 2 were Xenopsylla cheopis; 3 Ctenocephalus canis; 7 Echidnaphaga gallinacae. Lice on rats are rare—a mite of barely microscopic size is very common. It is being studied.

[2] Of the 94 fleas in latter period, 85 were chicken fleas from one dead rat.

Passed Asst. Surg. J. R. Ridlon, from Mayaguez, reports the following flea count:

Date.	Rats examined.	Fleas collected.	Average number fleas.	Total monthly rain in inches.	Xenopsylla cheopis.	Ctenocephalus canis.
1912.						
September	627	290	0.46	8.57	277	13
October	620	329	.53	23.35	274	55
November	221	110	.49	16.69	103	7
December	422	429	.90	.21	425	4

There is no marked difference shown in the number of fleas for the different months, but a tendency is shown for the number to increase during the month with the least rainfall.

The relation of fleas to rats varied on different days from 54 fleas from 3 rats to no fleas from 26 rats.

All rats were brought alive in traps to the laboratory and there chloroformed together with their fleas. The traps were brought to the laboratory inclosed tightly in a canvas sack or without covering. A comparative series of counts showed that no more fleas were found on the rats brought in the covered traps than those brought in the open traps.

The trap and all were placed in a can, the bottom of which was lined with paper. When the rats were dead they were combed and the interior of the can was searched carefully for fleas.

Asst. Surg. C. L. Williams, from Ponce, reports the following:

Date.	Number of live rats examined.	Number of fleas.
Sept. 1–Nov. 28	51	29 (Xenopsylla, 26; ctenocephalus, 3).
Nov. 29	30	9 (Xenopsylla).
Nov. 30	24	30 (Xenopsylla, 29; ctenocephalus, 1).
Dec. 1–9	103	45 (Xenopsylla, 39; ctenocephalus, 5; pulex irritans, 1).
Dec. 10–30	254	126 (Xenopsylla, 123; ctenocephalus, 3).

Dr. Williams reports not finding any *Rhynchoprion penetrans* or *Echidnaphaga gallinacæ* on the rats in Ponce. The contrast between the absence of the last species in Ponce and Mayaguez (on the southern and western sides of the island) in contrast to the frequency of rat infestation by this species in San Juan is noteworthy.

Human Cases.

As mentioned above, the first known case occurred June 10, though unrecognized at the time of burial. At the time of official proclamation of infection there had occurred 12 cases. The number increased to 31 on July 7, when the service took charge of eradicative measures. Thereafter occurred 24 cases, the last one on September 13. Of this series 36 died and 19 recovered. Of the total number 12 cases were diagnosed clinically, 3 cases by smears from aspirated bubo, and 40 cases by guinea-pig inoculation. Five cases were in the old city, 6 cases from La Marina, 5 cases from La Perla, 21 cases from Puerto de Tierra, 14 cases from Santurce. Outside of San Juan 3 cases were from Carolina and 1 from Dorado. One of the Carolina cases, though charged to Carolina because infection was contracted there, died some 4 miles distant from Carolina. One case charged to San Juan died on a schooner at Arroyo. He was taken ill shortly after leaving San Juan.

Infectivity of Houses.

Infectivity of houses sufficiently prolonged as to cause secondary cases was noted in four instances, three of which were in mampostería buildings. These, however, were in the first days of the epidemic before sulphur fumigation or rat proofing had commenced.

Acknowledgments.

It is desired to make acknowledgment to Dr. W. F. Lippitt, director of sanitation for Porto Rico, and to his subordinates in the insular department, for the fullest cooperation throughout the campaign. To all work done by the service toward plague eradication Dr. Lippitt extended his heartiest support. Without his effective assistance the comparatively early success in plague eradication could not have been obtained. The service officers are greatly indebted not only to the director of sanitation for generous support in the epidemic work, but also to Gov. George R. Colton, Acting Gov. M. Drew Carrel, and to the different departments in the insular government.

While all the field force that were retained throughout the service operations worked faithfully, Inspectors Juan Torres and Martín Paniagua are deserving special commendation.

Pharmacist F. L. Brown and Mrs. M. D. Hernández, secretary-interpreter, were unsparing in their labors and rendered invaluable service in the transaction of office affairs.

APPENDIX.

REGULATIONS GOVERNING THE CONSTRUCTION AND MAKING RAT PROOF OF ALL BUILDINGS AND OUTHOUSES IN THE ISLAND OF PORTO RICO.

SECTION 1. From and after the approval of these regulations, no house or building, storehouse, store, warehouse, etc., can be constructed without submitting to the sanitary service a special plan providing that the floor of the lower story be made of concrete when the floor is not to be a sufficient height from the ground to permit free access; or the wooden floor may be placed immediately on top of the concrete without leaving spaces which may serve as a refuge for rats; no wood or other inferior material shall be used under the flooring. Concrete floors shall have walls of concrete or stone extending at least two feet below the surface of surrounding ground and shall also have a concrete or masonry wall extending 1 foot above the level of the floor, the walls of buildings to fit flush on top of concrete or masonry walls; and what other means are to be adopted in order that said buildings and establishments may be rat proof are to be clearly specified. The sanitary service is authorized to approve or to make in said plans the changes which the case may require, without which approval the work, which must conform in each case to the definitely approved plans, can not be commenced.

The plans must be sent directly to the health officer: *Provided,* That these regulations shall be understood as amplifying the provisions concerning plans in the regulations now in force concerning constructions.

Sec. 2. In houses and buildings a ready constructed the following rules shall be observed:

Dwelling houses which have the floor of the lower story of wood shall be made rat proof by (1) raising the floor to a height of at least 2 feet from the ground with all underpinning free, or (2) shall have all space beneath flooring made rat proof by a foundation wall of stone or concrete extending below surface of ground to depth of 2 feet and fitting flush the floor of house. All decayed wood must be replaced.

Sec. 3. In no dwelling houses or buildings shall food, remnants of food, or other matter which may be made use of by rats be kept, except when placed in pantries, storerooms, or receptacles constructed so as to be inaccessible to said rodents.

Sec. 4. Roofs, garrets, courtyards, alleys, cellars, and any other open space belonging to houses or buildings must be kept free from food, garbage, forage, and other material which may serve as food or as refuge for rats.

Sec. 5. Sinks, drains, gutters, and private sewers shall be kept strictly clean.

Sec. 6. Coconut palm trees, mango-fruit trees, which furnish food for the rats and are situated in gardens or orchards of any house or building within the city limits or within the neighborhood of any town, at the discretion of the health officer and with the approval of the director of health, shall be kept free of rats, first exterminating those already existing and protecting the trunk of the trees with a band of tin or zinc and other suitable means to render the trees inaccessible to the rodents.

Sec. 7. Every building intended for a market, warehouse, storehouse, bakery, macaroni factory, distillery, pastry shops, stores, groceries, wine cellars, piers, hotels, cafés, restaurants, eating houses, and booths shall be subjected to the rules prescribed for dwelling houses and buildings: *Provided, notwithstanding,* That markets, piers, warehouses, and any storehouse of provisions must necessarily have the floor of concrete or plaster; and, further,

(*a*) Provisions and other articles in storehouses or on sale at wholesale or retail shall be kept in piles placed upon platforms which shall be at least a foot above the pavement and arranged in rows, leaving free spaces between to permit of easy cleaning and for sanitary inspection. The floor shall be kept free of provisions spilled either through breakage or through handling of the receptacles which contained them.

(*b*) Groceries, small shops, and other establishment which sell at retail shall have all the provisions for daily consumption in lockers or cupboards placed in such a way that they shall be inaccessible to rats.

Sec. 8. Lots and ground not built upon within the city limits shall be subjected to the preceding regulations which may be applicable.

Sec. 9. Barnyard fowls shall not be kept within the city limits of any town except under the following conditions:

A rat-proof henhouse shall be constructed which must have a concrete floor, as well as walls of the same material, which shall be sunk in the ground to a depth of 2 feet and raised 1 foot above the level of the floor. This surface must be surrounded by wire netting which shall have a half-inch mesh and be 6 feet high. Food intended for the fowls must be kept within these henhouses, so that it shall not be accessible to rats, and it will not be permitted in any case to deposit it outside.

Sec. 10. Stables and stalls within the city limits must fulfill the following conditions:

1. Each horse cared for shall have a space of not less than 5 square meters.
2. The floor shall be of concrete and with an adequate slope, as of one-eighth of an inch per foot.
3. Upon this concrete floor may be placed planks for a floor for the horses; this shall be made in parts or sections so that it may be easily raised. The boards which form the floor shall be separated by at least 2 inches.
4. The sections or parts of the floor must be raised once a week in order to do the necessary cleaning.
5. Each stable shall be provided with a well, lined with cement, in which to deposit the manure; the well to have a capacity of at least one-fourth of a cubic meter for each horse. Said receptacle shall have a well-fitting cover divided into two sections.
6. The manure shall be placed in said receptacles and carefully covered. The cleaning of said wells or receptacles shall be done once a week, and the manure carried to the place which the director of health may designate.
7. The stable, stall, manger, and their surroundings must be kept strictly clean.
8. Grain to be used as food for the live stock shall be kept in a rat-proof box.
9. Each manger shall be placed at a minimum distance of 2 feet from the wall or building, and its sides shall be covered with tin or zinc; and the said manger shall be at least 18 inches deep to avoid the spilling of food.

Sec. 11. These conditions must be fulfilled within a period of time which the director of health in each case shall fix in accordance with the importance of the work and the means to be obtained in that locality.

Sec. 12. Every infraction of any of the rules set forth in these regulations shall be punished with a maximum fine of $100, and the director of health shall have the necessary work done at the expense of the owner, in accordance with the law of sanitation in force: *Provided,* That those persons who prove that they do not possess more than one piece of property whose value does not exceed $100, according to the official assessment, shall be exempt from payment, and the said work shall be done in this case at the expense of the Public Treasury.

AMENDMENT TO SANITARY RULES AND REGULATIONS, APPROVED JANUARY 24, 1913, GOVERNING THE CONSTRUCTION AND MAKING RAT PROOF OF ALL BUILDINGS AND OUTHOUSES IN THE ISLAND OF PORTO RICO, APPROVED BY THE EXECUTIVE COUNCIL ON JULY 11, 1912.

Section 1. Sections 2, 4, 7, and 10 of the rules and regulations entitled "Sanitary Rules and Regulations No. 3, governing the construction and making rat proof of all buildings and outhouses in the island of Porto Rico, approved July 11, 1912," are hereby amended in the following manner:

Sec. 2. In houses and buildings already constructed the following rules shall be observed:

Dwelling houses and buildings intended for dry goods stores, warehouses or factories therefor, dressmaking establishments, banks and offices which have the floor of the lower story of wood, shall be made rat proof by (1) raising the floor to a height of at least 2 feet from the ground with all underpinning free, or (2) shall have all space beneath flooring made rat proof by a foundation wall of stone or concrete extending below the surface of the ground to a depth of 2 feet and fitting flush to floor of house. All decayed wood must be replaced.

Sec. 4. Roofs, garrets, courtyards, yards, alleys, cellars and any other open space belonging to houses or buildings must be kept free from food, garbage, forage, and other material which may serve as food or as refuge for rats. All masonry walls surrounding courtyards and yards which are not in good condition shall be made rat proof by being reinforced on the inner side with concrete to a depth of 2 feet below surface and 2 feet above level of ground.

Sec. 7. Every building the lower story of which is not intended for any of the uses specified in section 2 of these rules and regulations shall have the floor of the said lower story constructed in the following manner:

(*a*) Those intended for markets, piers, or storehouses for provisions at wholesale must necessarily have the floor of the lower story of concrete.

(*b*) Buildings intended for any other use shall also have the floor of concrete or plaster, except in localities in which, due to the nature of the ground or to the natural situation, the lower story of the building is at a height greater than 2 feet above the level of the ground, in which case wooden floors may be used, provided that the distance between the ground and the said floor be maintained (at least on three of its sides) absolutely free and with all underpinning free; provided further that if it should have one or more of its sides at a height less than 2 feet the same must rest upon a wall of stone or concrete, which shall extend below the surface of the ground to a depth of 2 feet and be raised 2 feet above the level of same.

(*c*) Buildings the lateral and rear walls of which are below the level of the ground or street must necessarily have the floor of concrete or plaster surrounded by a concrete or masonry wall extending 2 feet above the level of the floor and 2 feet below the surface of the same.

Sec. 10. Stables and stalls within the city limits must fulfill the following conditions:

1. Each horse cared for shall have a space of not less than 5 square meters.
2. The floors shall be of concrete and with an adequate slope as of one-eighth of an inch per foot and with a wall of concrete or stone extending 2 feet below the surface of the ground.
3. Upon this concrete floor may be placed planks for the horses, this to be made in sections, so that it may be easily raised. The boards which form the floor shall be separated from each other by at least 2 inches.
4. The sections or parts of the floor must be raised once a week in order to do the necessary cleaning
5. Each stable shall be provided with a well, lined with cement, in which to deposit the manure, the well to have a capacity of at least one-fourth cubic meter for each horse. Said receptacle shall have a tight-fitting cover divided into two sections.
6. The manure shall be placed in said receptacles and carefully covered. The cleaning of said wells or receptacles shall be done once a week and the manure carried to the place which the director of sanitation may designate.
7. The stable, stall, and manger and their surroundings must be kept strictly clean.
8. Grain to be used as food for the live stock shall be kept in a rat-proof box.
9. Each manger shall be placed at a minimum distance of 2 feet from the wall of building and its sides shall have a slope of 2 inches toward the bottom and shall be covered with tin or zinc, and the said manger shall be at least 18 inches deep to avoid the spilling of food.

REPORT OF CASE OF PLAGUE OCCURRING IN DORADO.

The following case history is reported because it occurred in a small town some 31 kilometers from San Juan, where no rat infection was discovered or other human cases developed and the source of infection was not clearly determined.

The facts elicited seem to point to an infection acquired by the boy, M. M, stealing a ride in a freight car from Dorado to Camuy three or four days prior to his death. The first symptoms were noted on Thursday, July 11, at which time the boy had severe headache, nausea, prostration, and fever. No buboes were noticed by the visiting physician. The patient grew worse, dying on Saturday, July 13, at which time he had a large femoral bubo. Autopsy was performed. Bipolar bacilli were observed in smear from the bubo, and guinea-pig inoculation confirmed the diagnosis of plague. The following factors bearing on the possible source of infection were obtained:

The boy worked in a sugar mill quite near Dorado. Each night he was accustomed to go to the railroad station to carry baggage. It is said he was inclined to spend much time in the vicinity of the station. On July 3 a cousin came from San Juan bringing a package of clothing.

She visited the house of the patient, returning to San Juan July 4, and came again to Dorado on July 11, the day on which the boy developed symptoms. On July 8 the boy had left Dorado hidden in a freight car and had journeyed as far as Arecibo or Camuy, a town a few miles west of Arecibo, returning home the next day. The freight train upon which he had ridden was from San Juan, stopping at Dorado en route to Arecibo and the western end of the island.

From this it is seen that there are three ways in which the child may have acquired infection: First, from infected rat in Dorado; second, through infected fleas in the clothing brought from San Juan by the cousin; and third, while hidden in the car of merchandise from San Juan to Camuy.

The first hypothesis seems untenable on account of no other cases developing in Dorado and no rodent infection being discovered, though he may have come in contact with some source of infection near the depot, either flea or rodent, that was not transmitted further than to the one case.

The probability of the infection being acquired from infected fleas in the clothing his cousin brought from San Juan seems remote. As the boy was already ill at the time of her second trip from San Juan, any consideration of this visit can be eliminated.

If the possibility of an infection at the time of her visit on July 3 be considered, the incubation would have been eight days, an exceptionally long period of time. At the time of the first and second visits there were no plague cases, either rat or human, in the immediate neighborhood of the San Juan house where the cousin lived. On July 27 there was a human case within three doors away, but this can hardly be considered as other than a coincidence.

There remains, then, the assumption that the boy contracted the infection while in the freight car. The period of time intervening between his ride and onset of symptoms coincides with the usual length of incubation—three or four days. The car was from the center of rat infection in San Juan, and his contact with any rats or fleas was quite prolonged. He possibly may have slept in the car overnight.

Another point of interest in this connection is the fact that rodent infection was later on discovered in Arecibo. This city is the destination of large quantities of freight traveling on the same branch of the railroad that the boy rode on. That infection was transported to Arecibo by means of rodents in merchandise seems the most plausible hypothesis.

TABULATION OF RODENT PLAGUE CASES.

SAN JUAN.

Rodent case serial No.	Date.	Species.	Diagnosis.	Kind of building taken from.	Treatment of premises.	Human cases.
1	June 22	Not recorded	Smear only	Frame building, combined grocery and dwelling.	Rat proofed in July; concrete floor and walls substituted for planking.	Case 28 July 5, case 31 July 13; 50 feet distant.
2	do	do	do	Unknown	None	
3	do	do	do	do	do	
4	do	do	do	do	do	
5	do	do	do	do	do	
6	do	do	do	In street	do	
7	June 23	do	do	Unknown	do	
8	do	do	do	do	do	
9	do	do	do	do	do	
10	do	do	do	do	do	
11	do	do	do	do	do	
12	do	do	do	do	do	
13	do	do	do	do	do	
14	do	do	do	do	do	
15	do	do	do	do	do	
16	June 24	M. musculus[1]	do	Frame dwelling	Destroyed	Case June 22.
17	do	do	do	do	do	Do.
18	do	Not recorded	do	Ship in San Juan Bay	Fumigated with sulphur	
19	do	do	do	do	do	
20	June 27	do	do	Frame dwelling	Rat proofed by elevation in July	
21	do	do	do	do	do	
22	June 29	do	do	Unknown		
23	do	do	do	do		
24	do	do	do	do		
25	June 30	M. norvegicus	Smear and gross lesions	Frame dwelling	Formaldehyde disinfection. Rat proofed latter part of July.	Case 31 July 21.
26	July 3	M. rattus	do	do	do	Case 23 July 3, case 25 July 3; 100 feet distant.
27	July 5	M. norvegicus	do	do	Rat proofed by elevation	
28	July 7	do	do	Grocery (Mamposteria)	Rat proofed	Case 2 June 19; across street.
29	do	do	do	Unknown		
30	July 8	do	do	Frame dwelling	Destroyed by owner in preference to rat proofing.	Case 21 June 23, case 23 July 3, case 25 July 3, case 32 July 2, case 40 July 31; all in immediate vicinity.
31	July 9	do	do	Street	General rat proofing in vicinity	
32	July 10	do	Gross lesions and animal inoculation.	do	do	

33	July 12	M. rattus	do	Frame dwelling	Rat proofed	
34	do	do	do	do	do	Case 27 July 4, across street.
35	do	M. norvegicus	do	do	do	
36	July 13	do	do	Frame dwelling and grocery combined.	do	
37	do	do	do	do	do	
38	do	do	do	Not known, erroneously tagged		
39	do	do	do	do		
40	do	do	do	Brick dwelling and grocery combined.	Rat proofed	
41	July 14	M. alexandrinus	do	Frame dwelling	do	Case 26 July 21, 100 yards distant.
42	July 16	M. norvegicus	do	Same as Nos. 36 and 37		
43	July 17	do	do	Street	Rat proofing of vicinity	See rodent case No. 30.
44	July 18	do	do	Frame dwelling	Rat proofed	In vicinity.
45	July 19	do	do	do	do	
46	do	do	do	do	do	
47	July 23	do	do	Brick dwelling	do	
48	July 24	M. rattus	do	Frame dwelling	Rat proofed	Case 11 June 19, case 13 June 19, case 20 June 22.
49	Aug. 8	M. norvegicus	do	do	Destroyed by owner in preference to rat proofing.	
50	Aug. 16	do	do	Street culvert	General rat proofing in vicinity	
51	Sept. 10	do	do	Combined frame restaurant and dwelling.	Evacuation and rat proofing with pulicidal measures.	
52	do	do	do	Stable	Same as No. 51	Case 9 June 19, 25 feet distance.

RIO PIEDRAS.

1	July 9	M. norvegicus	Gross lesions and animal inoculation.	Street	General rat proofing	No human case in Rio Piedras.

CAROLINA.

1	July 3	M. norvegicus	Gross lesions and animal inoculation.	Frame dwelling	General destruction of rat harborage and rat proofing in the village.	Case 1 June 27, case 2 June 28, case 3 July 16; all in small village.
2	do	do	do	do	do	
3	July 4	do	do	do	do	
4	July 5	do	do	Bakery	do	
5	do	do	do	do	do	
6	July 6	do	do	Street	do	
7	July 8	do	do	Frame dwelling	do	

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[1] On subsequent inquiry the laboratory attendant who had dissected the rodents and had prepared smears stated he was uncertain whether the rodents were young rats or mice.

TABULATION OF RODENT PLAGUE CASES—Continued.

CAGUAS.

Rodent case serial No.	Date.	Species.	Diagnosis.	Kind of building taken from.	Treatment of premises.	Human cases.
1	Sept. 23	M. norvegicus	Gross lesions and animal inoculation.	Combined grocery and dwelling	Evacuation, rat proofing, and pulicidal measures.	No known human cases occurred in Caguas.
2	Oct. 14	do	do	Street	do	
3	Dec. 9	do	do	Frame dwelling	do	
4	Dec. 21	do	do	do	do	

ARECIBO.

Rodent case serial No.	Date.	Species.	Diagnosis.	Kind of building taken from.	Treatment of premises.	Human cases.
1	Oct. 11	M. norvegicus	Gross lesions and animal inoculation.	Street	General rat proofing	No known human case occurred in Arecibo.
2	Oct. 26	do	do	do	do	

TABULATION OF HUMAN PLAGUE CASES.

SAN JUAN.

Human case serial No.	Date.	Age.	Sex.	Diagnosis.	Source of infection.	Treatment of premises.	Secondary cases.
1	June 15	20	Male	Clinical	Residence	Formaldehyde disinfection; rat proofed in July.	Case 4, case 16.
2	June 19	15	do	do	do	do	
3	June 15	35	do	do	do	do	
4	do	20	do	do	do	do	Cases 1 and 16.
5	June 17	20	do	Bacteriological	Warehouse where employed	Rat proofed in July	Case 6.
6	June 18	19	do	do	do	do	Case 5.
7	do	24	do	Clinical	Residence	Formaldehyde disinfection; rat proofed in July.	Cases 8 and 10.
8	do	33	Female	do	do	do	Cases 7 and 10.
9	do	16	Male	Bacteriological	do	Destroyed	
10	June 19	20	Female	do	do	See cases 7 and 8	
11	do	21	Male	do	do	Formaldehyde disinfection; rat proofed in July.	Cases 13 and 20.

12	...do....	28	.....do....	.....do	Docks where employed	Rat proofed in July	(?)
13	June 22	22	Female	.....do	Residence	Formaldehyde disinfection; rat proofed in July.	Case 11.
14	...do....	38	.....do....	.....do	.....do	Destroyed	
15	June 19	28	.....do....	Clinical	.....do	Formaldehyde disinfection; rat proofed in July.	
16	June 20	20	Male	Bacteriological	.....do	See cases 1 and 4	
17	June 22	38	.....do....	.....do	Not known, locations visited in Puerta de Tierra.	A frequent visitor in Puerta de Tierra	
18	June 20	33	.....do....	Clinically	Residence	Formaldehyde disinfection; rat proofed in August.	
19	June 22	21	.....do....	Bacteriological	.....do	Destroyed	
20	...do....	32	.....do....	.....do	.....do	See cases 11 and 13	
21	June 23	30	.....do....	.....do	.....do	Formaldehyde disinfection; rat proofed in July.	
22	...do....	10	.....do....	Clinical	.....do	Formaldehyde disinfection; rat proofed in August.	
23	June 27	20	.....do....	Bacteriological	.....do	Formaldehyde disinfection; rat proofed in July.	Case 25 in proximity.
24	July 1	45	.....do....	.....do	Unknown	Site of infection unknown, was a vender of ice cream in Puerta de Tierra.	
25	July 3	32	.....do....	.....do	Residence	See case 23	
26	...do....	11	.....do....	.....do	.....do	Rat proofed	
27	July 4	26	.....do....	.....do	.....do	.....do	
28	July 5	36	Female	Clinical	.....do	.....do	Case 3 in proximity.
29	July 7	11	Male	Bacteriological	.....do	.....do	
30	July 12	38	.....do....	.....do	.....do	.....do	
31	...do....	9	.....do....	Clinical	.....do	.....do	
32	...do....	23	.....do....	Bacteriological	.....do	.....do	
33	July 18	22	Female	.....do	.....do	.....do	
34	July 21	18	.....do....	.....do	.....do	Sulphur fumigation; rat proofed	
35	...do....	12	Male	.....do	.....do	.....do	
36	...do....	18	Female	.....do	.....do	.....do	
37	July 23	24	Male	.....do	.....do	.....do	
38	July 27	20	.....do....	.....do	.....do	.....do	
39	July 30	12	.....do....	.....do	Not known	Street urchin in La Marina	
40	July 31	11	.....do....	.....do	Residence	Sulphur fumigation; rat proofed	
41	June 23	(?)	.....do....	Clinical	Died at sea on schooner from San Juan. Case should follow No. 18 in chronological order.		
42	Aug. 3	16	.....do....	Bacteriological	Residence	Sulphur fumigation; rat proofed	
43	Aug. 5	13	Female	.....do	.....do	.....do	
44	Aug. 15	19	Male	.....do	.....do	Destroyed; small dugout	
45	Aug. 30	24?	.....do....	.....do	.....do	Rat proofed	
46	Sept. 4	18?	Female	.....do	.....do	Sulphur fumigation; rat-proofed	
47	Sept. 5	6	Male	.....do	.....do	.....do	Cases 49, 50, and 51.
48	Sept. 6	60	Female	.....do	.....do	.....do	
49	Sept. 7	6	Male	.....do	.....do	.....do	Cases 47, 50, and 51.
50	Sept. 11	25	.....do....	.....do	Had acquired infection at residence of case 47, which was vacated Sept. 7.		
51	Sept. 13	3	Female	.....do	See case 50		

TABULATION OF HUMAN PLAGUE CASES—Continued.

CAROLINA.

Hum case serial No.	Date.	Age.	Sex.	Diagnosis.	Source of infection.	Treatment of premises.	Secondary cases.
1	June 26	38	Male	Bacteriological	Warehouse where employed	Rat proofed in July	
2	June 28	20	do		See case 3. Case 2 died in Loia, but acquired infection in Carolina.		
3	July 16	18	do	Bacteriological	Residence	Destroyed	

DORADO.

1	July 13	13	Male	Bacteriological	(1)	General rat proofing	

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[1] Boy was a stowaway in freight car filled with San Juan merchandise from Dorado to Camuy (24 hours) 3 days prior to onset of symptoms.

Plague-Eradicative Measures in Arecibo.

By J. R. Ridlon, Assistant Surgeon, United States Public Health Service.

Work was carried on from January 3 to February 15, 1913, and consisted of measures for rat-proofing buildings and the extermination and laboratory examination of rodents.

Previous to this time two plague infected rats had been found in Arecibo, and it seemed imperative that a vigorous campaign of rat extermination and rat proofing should be carried out.

Arecibo is a seaport town on the northern coast of Porto Rico, with about 15,000 inhabitants. The most common type of buildings was a wooden structure, and many had little if any elevation from the ground. Many of these buildings had a roof of Spanish tile, which afforded rat harborage. Here also roofs of thatch or similar construction were quite prevalent. These were found to harbor rats and had to be replaced by roofs of zinc or sheet iron.

All houses, except in the outlying barrios were inspected, and notices sent to the owners ordering changes making them rat proof.

It was necessary to discontinue service operations before all owners had had time to make the required changes, only about one-half having had time to comply.

When the work in Arecibo was taken over by the Public Health Service, records of inspections already made by the insular sanitary service were kindly turned over for our use, and at the termination of our work we turned over our records of inspections to facilitate the continuation of the work by the insular department of sanitation.

Summary of rat-proofing operations.

Dwellings inspected	1,342
Food depots	105
Stables	5
Notices served	728

LABORATORY OPERATIONS.

From January 21 to February 15 a laboratory was maintained at Arecibo for the examination of rats from the three towns of Arecibo, Manati, and Aguadilla.

A force of 10 rat catchers, with 2 foremen, was employed in Arecibo and the number of rats in the town reduced to a minimum.

During this time no plague-infected rat was found in Arecibo. A classification of rats examined follows:

Rat examination from Jan. 21 to Feb. 14, 1913.

Species:	
Mus norvegicus	544
Mus rattus	92
Mus alexandrinus	286
	922
Place where collected:	
Arecibo	449
Manati	191
Aguadilla	282
	922

Plague-Eradicative Measures in Caguas.

By C. L. Williams, Assistant Surgeon, United States Public Health Service.

Previous to my arrival the work had been progressing under the insular service of sanitation except for a short period in September, subsequent to the discovery of infection among the rats, when the Public Health Service had control. I found that a great deal of work had been done by the service of sanitation; nearly the entire town had been inspected, and several hundred notices to rat-proof buildings served with 111 compliances on record.

Unfortunately in the process of transferring plague eradicative functions from the insular service of sanitation to the United States Public Health Service, the records became mixed and a great many were lost. This retarded the work somewhat and has rendered it impossible to make a precise report of the work done, the sudden discontinuance of work coming at a time when a resurvey of the city was in progress to complete the records. There are on file records of 1,063 buildings. It is estimated that records of 400 houses are missing.

The methods of rat proofing followed the same lines as in San Juan and Ponce, with a few modifications due to local conditions. The town consisted largely of small frame houses flat on the ground and mostly in poor condition. These were all ordered to be raised 2 feet with underpinning free, without option of placing a concrete wall around perimeter unless an entirely new floor was laid in the building. In addition a great many of the houses were found with country tile roofs, most of them ideal rat harbors. These were all ordered changed for other material that would be rat proof, sheet iron being the most common substitutes used. A few owners were allowed to rat proof the tiles by having them laid on narrow strips, leaving the tiles accessible from below and filling up all openings and cracks with cement. Food depots were ordered to have concrete floors with side walls 2 feet in the ground and 1 foot above level of floor; double floors and walls were ordered rat proofed with 2-inch boards; bad latrines were ordered rebuilt of concrete, and garbage cans required supplied where lacking. Many other minor matters were ordered repaired, by notice or verbally.

As stated above, the condition of the records renders precise statements impossible. A compilation of those on hand which represent 1,063 houses of a total of not over 1,500, shows the following:

Tabulation of buildings in Caguas.

Total number of buildings, estimated	1,463
Number of buildings inspected	1,063
Number of buildings passed as satisfactory	46
Number of buildings notified to be rat proofed	1,017
Buildings in which rat proofing was enforced by insular service of sanitation	111
Buildings in which rat proofing was enforced by Public Health Service	360
Buildings in which work was progressing at time of discontinuance of service operations, Feb. 15	161
Buildings that have not been repaired according to orders	385
Total	1,017

Buildings rat proofed.

Food depots	54
Stables	1
Dwellings	305
Total	360

NOTE.—Does not include the 111 enforced by insular service of sanitation.

Methods of rat proofing.

FOOD DEPOTS.

Concrete floors	54
Tile roofs changed or made rat proof	17

DWELLINGS.

Elevated with underpinning free	226
Concrete wall around perimeter, fittings flush with floor	57
Tile roofs changed or made rat proof	85
Latrines rebuilt of concrete	26
Houses destroyed	10

NOTE.—Many minor repairs are not listed in this table.

Plague-Eradicative Measures in Carolina.

By C. L. WILLIAMS, Assistant Surgeon, United States Public Health Service.

Before my arrival in Carolina the department of sanitation had started to work, having torn down several rat-infested houses.

Under the direction of Dr. Malaret, of the service of sanitation, and myself, the work has consisted chiefly in tearing up the floors of stores and warehouses and killing the rats and in thoroughly cleaning up all rubbish. All houses were first surrounded by a ½-inch mesh wire fence to prevent escape of rats.

While stores and warehouses, being considered the principal rat centers, received most attention, the floors of dwelling houses that appeared rat infested or likely to harbor rats driven out elsewhere were torn up as well. In three instances frame houses were torn down, being so infirm as to render tearing up of floors unsafe for workmen. One large store and storehouse of mampostería construction was almost entirely destroyed, it having been shown to be a center of infection and its walls being riddled with rat holes. The flooring of a bakery, just outside of the town, was torn up on account of an infected rat being reported from there. One hundred and ten rats were killed; none of them infected.

In many instances where stores had concrete floors unprotected by side walls going 2 feet into the ground the rats were found in burrows under the concrete floor, often as far as 6 feet from the edge of the floor. In three cases rats were caught in burrows ending beneath brick walls sunk a foot and a half, and in one instance over 2 feet into the ground.

The favorite location for the rats was, in the great majority of cases, in and around latrines. Most of the latrines are constructed of soft brick and except in those cases when they were entirely free on all sides were found to be rat harbors. Many of them were destroyed in order to catch and kill the rats.

In conjunction with the more active measures, I made a house-to-house inspection of the entire town and directed the tenants regarding the measures to be taken to rat proof each house. Much work has been done by them.

Tabulation of work performed.

Number of houses		418
Number of food depots		26
Number of stables		3
Houses destroyed	Mamposteria	1
	Frame	3
Floors torn up	Cement	4
	Wooden	35
Latrines destroyed		22
Yards cleaned out		17
Rats caught, approximately		350

Improvements ordered.

Houses ordered raised to height of 2 feet	73
Houses to be raised by excavation beneath	60
Concrete floors ordered in stores or warehouses	19
Latrines ordered rebuilt of concrete	58
Latrines to be rat proofed with facing of concrete on outside and concrete top	137

Houses already rat proof.

Raised 2 feet or more	152
Houses in Cabro Sucio raised 2 feet or more, estimated	100
Houses with rat-proof concrete floors	10

As a model to be followed in reconstruction of latrines, a latrine of concrete was built by the service of sanitation under my direction.

Plague-Preventive Measures at Mayaguez.

By J. R. Ridlon, Assistant Surgeon, United States Public Health Service.

Plague eradicative measures were commenced on September 1, 1912, and continued to February 15, 1913. The work may be divided into two parts: Measures taken in regard to rat proofing of buildings and measures taken in regard to rat extermination.

Mayaguez has a population of about 20,000. Most of the buildings on the main streets are of mamposteria construction, while those in the outlying districts are mostly of frame construction.

The requirements for rat proofing were enforced. The essential requirements for dwellings are an elevation of 2 feet with clear underpinning or surrounding the lower story with a concrete wall extending 2 feet below the surface of the ground and perfectly adjusted to the floor, and for food depots a concrete floor with walls extending 2 feet below the surface of the ground and 1 foot above the floor level.

Buildings were inspected and notices containing specifications of the necessary changes sent to the owners.

A summary of the inspections and compliances from September 1, 1912, to February 15, 1913, follows:

Dwellings inspected	1,717
Food depots	209
Notices served	1,141
Corrections made	904
Groceries out of business	14

Rat proofing in Mayaguez from Sept. 1, 1912, to Feb. 15, 1913.

Nature of corrections.	Number of corrections.	Cost of corrections.
Dwellings surrounded by concrete wall extending 2 feet below the surface of the ground and perfectly adjusted to the floor	353	$5,331
Food depots, concrete floors, with concrete walls 2 feet below the surface of the ground and 1 foot above the floor level	174	19,475
Dwellings, elevation of 2 feet, secured by raising the building or excavation beneath.	88	663
Miscellaneous, including renovation of wooden floors and rat proofing double walls	275	706
Food depots out of business	14	....
Total	904	26,175

EXTERMINATION OF RODENTS.

A force of 10 to 12 men was employed from August 29 to December 30 in rat catching and a laboratory maintained for the examination of rodents from August 29 to October 31, inclusive, and from November 16 to December 30, inclusive.

Both wire-cage traps and snap traps were used. All rats were dissected and carefully examined after their fleas were killed by immersion in petroleum solution or by chloroform. During this time no plague-infected rat was found.

A summary of rat examinations from August 29 to October 31, inclusive, and from November 16 to December 30, 1912, follows, all rats examined being caught in Mayaguez:

	Negative.
Mus norvegicus	4,432
Mus rattus	303
Mus alexandrinus	813
Mus musculus	152
Mongoose	20
Total	5,720
No plague-infected rodent was found.	

FLEA INFESTATION OF RATS IN MAYAGUEZ.

A flea survey was carried on in connection with the examination of rats for plague infection in Mayaguez during the last months of 1912. All rats were brought alive in traps to the laboratory and there chloroformed, together with their fleas. The traps were brought to the laboratory inclosed tightly in a canvas sack or without covering. A comparative series of counts showed that no more fleas were found on the rats brought in the covered traps than those brought in the open traps.

The trap and contents were placed in a can, the bottom of which was lined with paper. When the rats were dead, they were combed and the interior of the can was searched carefully for fleas.

The following table shows the result obtained:

Flea infestation of rats.

Months.	Number of rats examined.	Number of fleas collected.	Average number fleas per rat.	Mean monthly temperature.	Total monthly rain.
1912.					*Inches.*
September	627	290	0.46	78.4	8.57
October	620	329	.53	78.1	23.35
November	221	110	.49	77.3	16.69
December	472	429	.90	76.9	.21
Total	1,940	1,158	.64	....	....

There is no marked difference shown in the number of fleas for the different months, but a tendency is shown for the number of fleas to increase during the month with least rainfall.

The relation of fleas to rats varied on different days from 54 fleas from 3 rats to no fleas from 26 rats.

A classification of fleas follows:

Classification of fleas.

Month.	Number of fleas collected.	Xenopsylla cheopis.	Ctenocephalus canis.	Percentage of Xenopsylla cheopis.
1912.				
September	290	277	13	95
October	329	274	55	83
November	110	103	7	93
December	429	425	4	99
Total	1,158	1,079	79	....

It is here seen that the *Xenopsylla cheopis* (Rothschild) is the prevalent rat flea in this section and is the same flea that has been proven by workers in India as being most concerned in the transmission of plague.

Identification of fleas was confirmed by the Bureau of Entomology, Department of Agriculture.

Plague-Preventive Measures in Ponce.

By C. L. Williams, Assistant Surgeon, United States Public Health Service.

On my arrival in Ponce inspectors and a rat-catching force consisting of 12 laborers, 3 foremen, and 2 laboratory assistants were employed. Wire traps to the number of 240 were already in use in the city. These were turned over by the service of sanitation and 724 snap traps were sent from San Juan. They were all distributed to the rat catchers, and the catching and examining of rats was begun at once. A suitable laboratory was furnished and equipped by the service of sanitation.

The city was divided into 12 districts, 10 in the city proper and 2 in the playa, or water front, which is about 2 miles from the rest of the city and contains most of the large warehouses. There are no docks with the exception of one under construction which will be, I believe, when completed as near rat proof as it is practicable to make a dock, concrete and metal only being used in construction. Each inspector was given 6 districts.

As food depots and stables were considered the most important they were inspected, notified, and the notices enforced before dwellings were taken up. On account of the unsatisfactory system of numbering in Ponce, each house was numbered as inspected, a card with district and house number being used.

The records of inspection were made on special blanks and brought to the office. Notices were then issued to the owners of houses not rat proof, allowing usually 15 days for compliance. If not complied with the case was taken to court or the building closed, the latter method being much more efficacious for stores and warehouses.

The methods of rat proofing followed the same lines as in San Juan, with the exception that none of the mamposteria construction of the same nature as that found in San Juan exists in Ponce. The old masonry here consists of stone or brick with a mortar made of sand and lime instead of sand, mud, and lime, and is much firmer and more lasting than that in San Juan. A 1-inch facing of cement on these walls made them amply rat proof.

Dwellings of frame were required to be raised 2 feet with underpinning free or surrounded with concrete wall 2 feet deep and fitting flush with floor, replacing all rotten wood. Practically all masonry buildings have foundations 3 feet deep, so that dwellings of this type, as well as dry goods stores and hardware shops of similar construction, were required only to thoroughly repair floors. Food storehouses were required to have cement floors with concrete walls at edge extending 2 feet into the ground and 1 foot above floor level. Latrines in poor condition were ordered rebuilt of concrete. Trees were surrounded with a band of tin, and feeding pens were required for chickens, with the result that they almost disappeared from the city. Stables were required to comply with the regulations promulgated for such buildings in the rat-proofing law.

Some buildings in too bad condition to repair were ordered destroyed. Nearly all stores and stables have been rat proofed. In the playa there remain very few buildings of any description that may harbor rats. The houses along the road between the playa and city proper, on account of frequent floods, are mostly raised. Of the dwellings in the city that were ordered repaired, the work on over 50 per cent has been completed.

A remarkable tendency to construct raised houses is seen in Ponce as shown by the appended tables in which it is seen that 85 per cent of the dwellings were found rat proof. Masonry houses were for the most part found in good condition and only a few needed extensive floor repairs. The reason for this tendency to build raised houses is probably the frequent floods that inundate the city in the wet season.

Tabulation of work accomplished in Ponce.

Population	46,000
Total number of buildings	8,321
Number of buildings passed as satisfactory	6,835
Number of buildings ordered to be repaired	1,477
Number of buildings in which orders were complied with	958
Number of buildings in which orders were not complied with	[1] 528

Methods of rat proofing—Food depots.

Concrete floors	301
Elevated 2 feet with underpinning free	9
Destroyed	4
Latrines rebuilt	15
Minor repairs	61

Methods of rat proofing—Dwellings.

Elevated 2 feet with underpinning free	492
Surrounded with concrete wall 2 feet deep fitting flush with floor	16
Repaired floor	39
Latrines rebuilt	126
Minor repairs	38
Destroyed	15

Methods of rat proofing—Stables.

Number made to conform to regulations of service of sanitation	43

LABORATORY REPORT.

Rats.—The laboratory report only covers the work from August 26, 1912, to January 1, 1913, when the laborary was discontinued. In that time 2,654 rats were killed and examined. None of these was found infected with plague. The weekly reports of rats caught show an increase in the first few weeks, after which the numbers remain fairly constant until the last month, when there is a slight decline. During December there was a greater number of *Mus alexandrinus* and *Mus rattus* caught.

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[1] Of these 519 were dwellings.

Fleas.—A limited flea survey was made between the dates of November 29 and December 30. Rats were examined for fleas, 237 being taken from them. The flea count varied considerably with different lots of rats. The greatest number of fleas on any one rat was 10, found on each of two specimens, one a Norvegicus the other an Alexandrinus. All these rats were brought to the laboratory alive and chloroformed in a closed bucket, the bottom being covered with white paper. Two species of mites, two species of anopleura, were also found on the rats, as well as an unidentified insect of the class rhynchota. No chigoes were found.

NOTES OF AN INFECTIOUS DISEASE RESEMBLING PLAGUE.

During the first month or two of the laboratory a considerable number of rats from the playa showed skin injection, markedly enlarged inguinal glands and enlarged but not particulary dark spleen. I had seen several plague-infected rats in San Juan with almost identical lesions. All of these, however, proved negative to guinea pigs. After the second month more cases were found. In smears from the glands and spleen no constant organism could be discovered.

Rats examined.

Week ending—	Mus norvegicus.	Mus alexandrinus.	Mus rattus.	Total.
Aug. 31				9
Sept. 7				65
Sept. 14				74
Sept. 21	88	42	8	138
Sept. 28	152	24	7	183
Oct. 5	135	72	8	235
Oct. 12	118	34	8	160
Oct. 19	149	57	4	210
Oct. 26	99	62	13	174
Nov. 2	104	50	12	166
Nov. 9	97	41	5	143
Nov. 16	115	40	6	161
Nov. 23	80	52	8	140
Nov. 30	77	58	14	149
Dec. 7	73	67	24	164
Dec. 14	87	64	20	171
Dec. 21	81	82	27	190
Dec. 28	62	47	13	122
Total	1,537	792	177	2,656

Rats examined for fleas.

Number of rats examined	462
Fleas found	237

Percentage of infestation, 0.51 flea per rat.

Classification of fleas.

Xenopsylla cheopis	226
Ctenocephalus canis	10
Pulex irritans	1

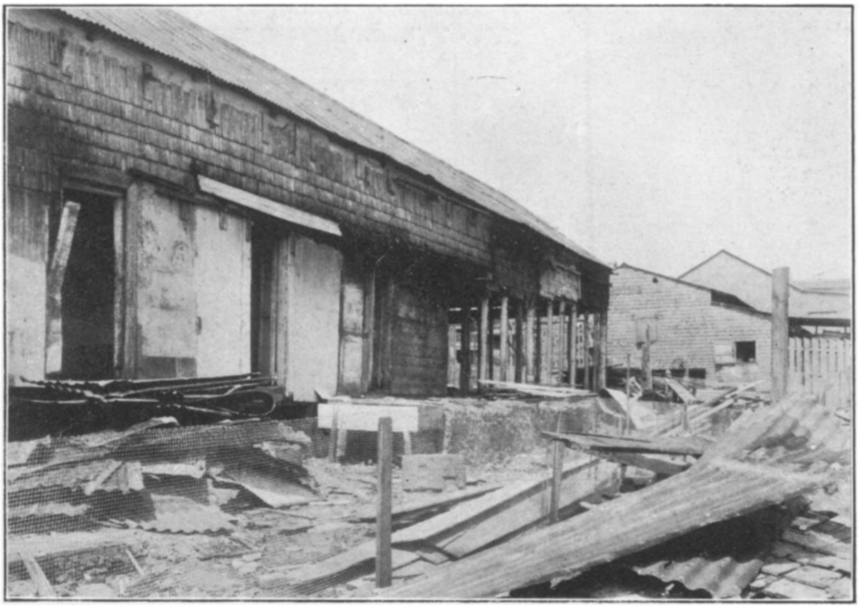

Fig. 6.—SITE OF RODENT PLAGUE IN PUERTA DE TIERRA. DESTROYED BY OWNER IN PREFERENCE TO RAT PROOFING.

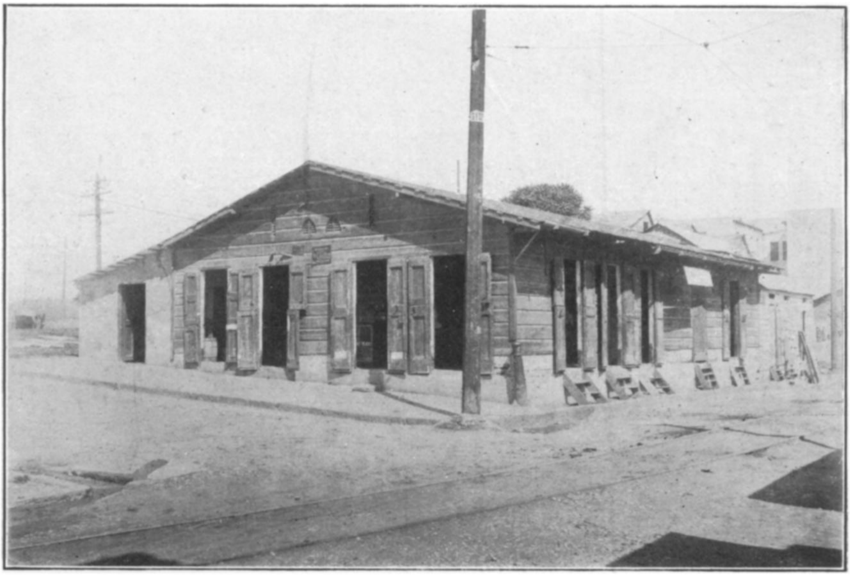

Fig. 7.—SITE OF HUMAN PLAGUE IN PUERTA DE TIERRA. RAT PROOFED BY CONCRETE WALLS AND FLOOR.

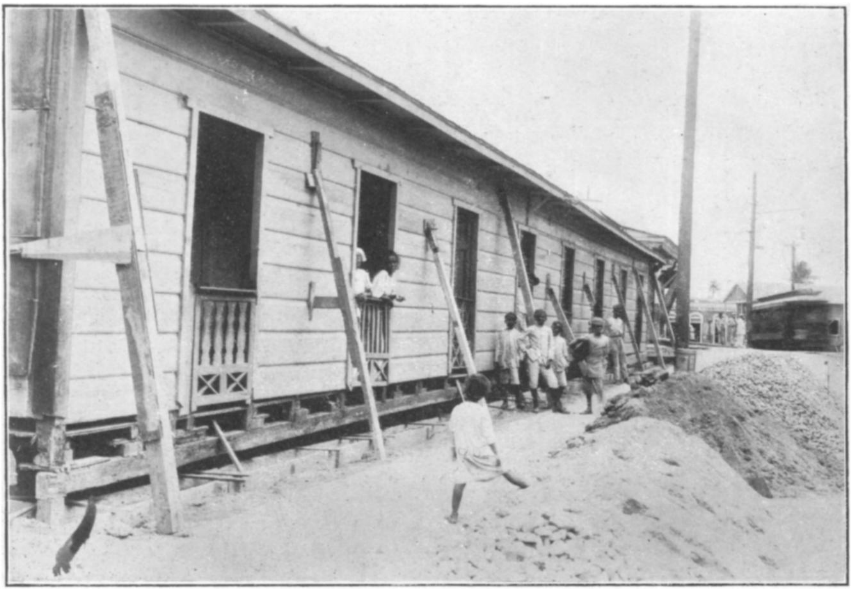

Fig. 8.—STREET SCENE IN PUERTA DE TIERRA PRELIMINARY TO RAT PROOFING.

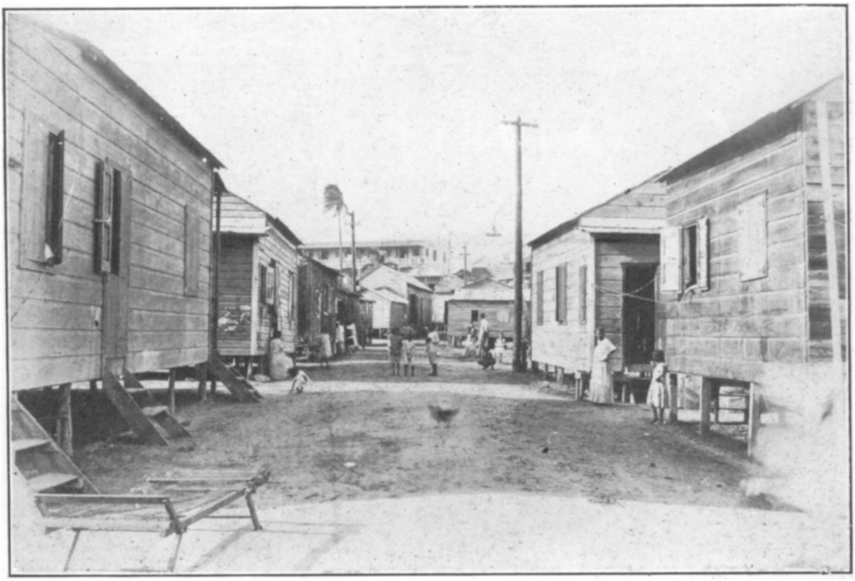

Fig. 9.—SCENE IN SOUTH PUERTA DE TIERRA SUBSEQUENT TO RAT PROOFING BY ELEVATION.

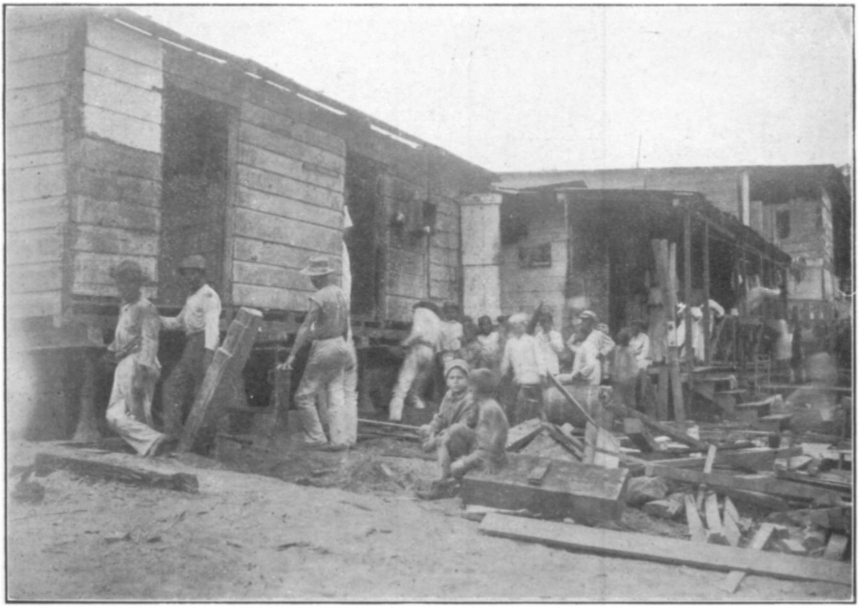

Fig. 10.—RAT-PROOFING SCENE IN PUERTA DE TIERRA.